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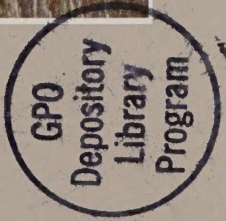
AIR POLLUTION IMPACT ON SOUTHERN FORESTS

Southeastern Forest
Experiment Station



Slash Pines On Coastal Plain Soils

AUSTIN CARY FOREST
UNIVERSITY OF FLORIDA



APR 1960



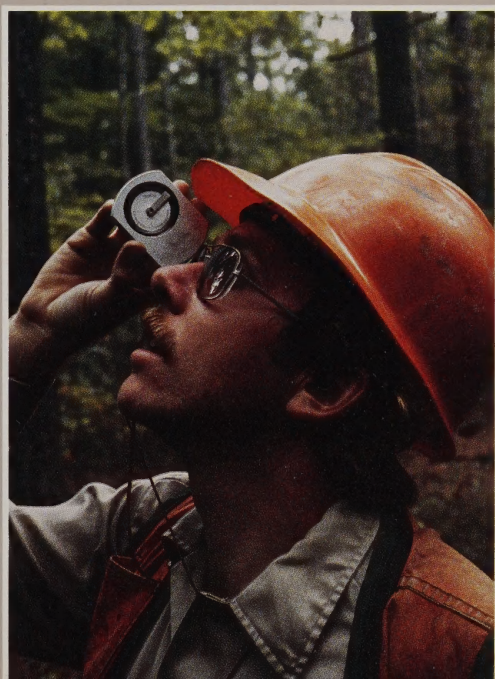
Insect devastation at high elevations in western North Carolina. Researchers are concerned about a possible link to airborne pollutants.

Throughout the Northern Hemisphere, concern has been growing about the effects of air pollution on forest ecosystems. Various pollutants, including acid precipitation (acid rain), have been implicated in the disappearance of aquatic life and in forest dieback. And over the past decade, researchers have shown that ambient levels of some airborne pollutants, including ozone, reduce the yield of soybeans, cotton, and other important crops.

At the same time, surveys taken by the Southeastern Forest Experiment Station of the USDA Forest Service indicate that natural stands of commercially important conifers – loblolly, shortleaf, and slash pine found in coastal, Piedmont, and lower mountain regions – are not growing as rapidly as in previous decades. Several reasons have been suggested, with a major concern surrounding airborne chemicals.

These events led to the creation of the Southern Commercial Forest Research Cooperative (SCFRC) and the Austin Cary Intensive Research Site.

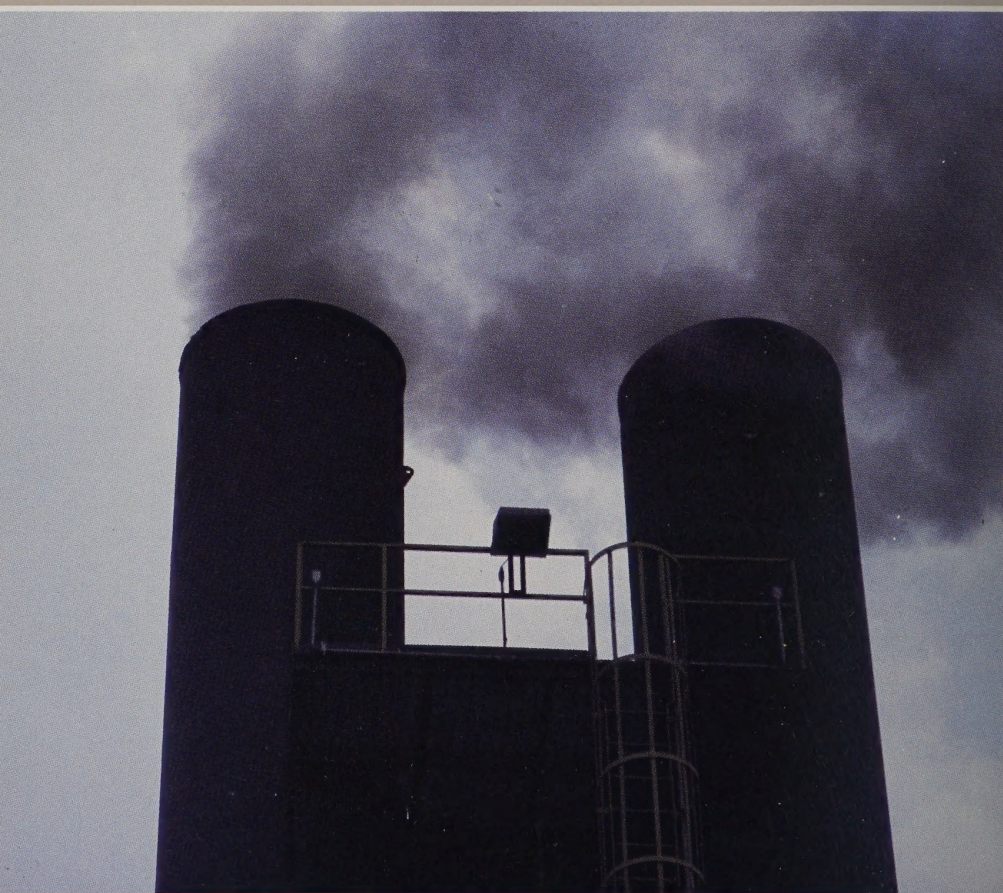
Surveys show that natural stands of important conifers are not growing as rapidly as in previous decades.



What are the pollutants?

There are three main gaseous pollutants of concern – sulfur dioxide (SO_2), nitrogen oxides (NO_x) and ozone (O_3). The burning of fossil fuels, such as in smelters and coal-fired power stations, produces both SO_2 and NO_x . Motor vehicles produce NO_x and hydrocarbons, the basic ingredients in the formation of ozone.

In their gaseous state, these pollutants can affect plants directly by a process called dry deposition.



SO_2 and NO_x from smokestacks can return to the earth as acid rain.



Motor vehicles produce NO_x and hydrocarbons, the basic ingredients in the formation of ozone.

Also, SO_2 and NO_x can transform into weak acids in the atmosphere (SO_4^{-2} and NO_3^{-1}) and return to the earth as acid precipitation.

Initial studies on forest decline in Europe have centered on acid precipitation, but it now appears that ozone may also have an important role.

Concentrations of ambient ozone in the Southern United States have been above normal for some time. The acidity of rainfall has also increased significantly in many areas.

The Austin Cary Intensive Research Site

The growth of southern pines is affected by many environmental influences, including moisture, nutrients, competition, and site characteristics. Although air pollution is known to be a factor, the extent of impact is difficult to isolate and assess in natural settings.

In 1987, an Intensive Research Site was established at the University of Florida's Austin Cary Experimental Forest to show how pollutants affect the development of slash pines. To control concentrations around the trees and exclude natural rainfall, the experimental design calls for top-vented field chambers covered with clear plastic. The chambers are 16 feet high and 15 feet in diameter to accommodate larger trees. Air is continually pulled through each chamber, keeping temperatures near ambient and allowing for the introduction of gaseous pollutants.





In 16-foot chambers, slash pines are exposed to ozone and acid rain over a 4 year period.



The Austin Cary Research Site was established at the University of Florida's Austin Cary Forest near Gainesville.

Scientists use outdoor chambers to assess the effects of air pollution in natural settings.

What exactly is examined?

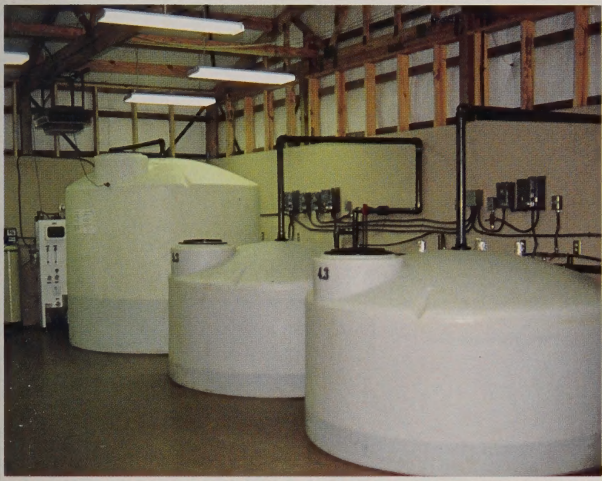
In 1987, scientists began a 4-year study comparing trees exposed to ambient and charcoal filtered air with those exposed to ozone at four concentrations and rain acidity at three concentrations. Ozone is pumped through ventilation units 12 hours a day, 365 days a year. Acid rain is applied through an overhead irrigation system according to historical rainfall patterns.

Investigators monitor tree growth by measuring height and stem diameter. They also monitor changes in the trees' physiological state.



Inside chambers, unexposed seedlings (left) and seedlings exposed to 3 times the ambient level of ozone (right). Note the loss of needles and stems from the main trunk.

This information is analyzed to provide an integrated picture of how slash pine responds when exposed to ozone and acid precipitation. It will also be useful in predicting how changes in air quality could affect forest productivity.



Scientists use advanced technology to apply and monitor doses of pollutants.





The Austin Cary Intensive Research Site is a cooperative effort, involving government agencies and universities.

Research Cooperatives: Pooling Resources for Maximum Effect

The Southern Commercial Forest Research Cooperative (SCFRC) is one of five cooperatives formed by a joint planning team from the USDA Forest Service and the United States Environmental Protection Agency. This major research effort is managed by the Southeastern Station and linked to the National Acid Precipitation Assessment Program (NAPAP) through NAPAP's Forest Response Program.

The Austin Cary Intensive Research Site is one of five such facilities developed by SCFRC. It is administered in cooperation with the University of Florida.

What else is happening?

SCFRC is conducting similar studies throughout the South, with other intensive sites on Experimental Forests at Auburn, Clemson, and Duke Universities, and at the Texas Agricultural Experiment Station. The Cooperative also maintains the greenhouse complex at Macon, GA, where thousands of seedlings are exposed to a variety of pollutants.

In addition to SCFRC, the Macon Testing Center, and the five Intensive Research Sites, the Southeastern Station manages several other regional studies:

- The Vegetation Survey Program at Research Triangle Park is building a data base to determine whether air pollutants are contributing to the current decline of southern forests.
- The Coweeta Laboratory in Franklin, NC, is testing the ability of watershed ecosystems to tolerate a variety of pollutants.

Together, these investigations will provide basic information on the relationship between air pollution and the growth of southern forests.

What about the future?



Current studies at the Austin Cary Intensive Research Site are scheduled to end in 1990. While a tremendous amount of information will have been gathered at this and other intensive sites, many questions concerning the effects of air pollutants on trees will remain unanswered. Additional studies will be needed. These studies may be concerned with additional air pollution research, or they may address other emerging issues. The facilities developed by the SCFRC were designed to have great potential beyond their current use. Some examples of studies for which these facilities are readily adaptable are:

- Studies addressing global climate change issues, such as effects of elevated carbon dioxide on tree growth and physiology.
- Research on the deterioration of the stratospheric ozone layer, such as evaluating the impact of increased levels of ultraviolet radiation on trees.

Because of their flexibility, the SCFRC views the intensive sites as an investment that will pay dividends far into the future.

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For more information or a tour
of the Austin Cary Site, contact:

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